Indicator: Submerged Aquatic Vegetation in Chesapeake Bay (317R)

Submerged Aquatic Vegetation (SAV) is important to most aquatic ecosystems. For example, SAV produces oxygen, supplies food for many species (especially waterfowl), offers shelter and nursery habitat for fish and shellfish, reduces wave action and shoreline erosion, absorbs excess nutrients, such as nitrogen and phosphorus, and traps sediments. The loss of SAV from shallow waters of Chesapeake Bay, which was first noted in the early 1960s, is a widespread, well documented problem (Batiuk, et al., 2000). Although other factors, such as climatic events and herbicide toxicity, may have contributed to the decline of SAV in the Bay, the primary causes are eutrophication and associated reductions in light availability (Batiuk, et. al., 2000). Trends in the distribution and abundance of SAV over time are useful in understanding trends in water quality (Moore, et. al. 2004). Review of photographic evidence from a number of sites dating back to 1937 suggests that close to 200,000 acres of SAV may have historically grown along the shoreline of the Bay (Moore, et. al. 2004). However, by 1984, the SAV community had fallen to a low of about 38,000 acres (Virginia Institute of Marine Science).

This indicator presents the distribution of SAV in Chesapeake Bay and its tributaries from 1978-2003, as mapped from black and white aerial photographs. The surveys follow fixed flight routes over shallow water areas of the Bay to comprehensively survey all tidal shallow water areas of the Bay and its tidal tributaries. Non-tidal areas are omitted from the survey. SAV beds less than 1 square meter are not included due to the limits of the photography and interpretation. Annual monitoring began in1978, however no surveys were conducted from 1979-1983 or in 1988. In events where the entire area could not be surveyed due to flight restrictions or weather events, estimates were included.

What the Data Show

The extent of SAV in the Chesapeake Bay increased during the monitoring period, from 41,000 acres in 1978 to 65,000 acres in 2003 (Figure 317R-1). The maximum annual extent of SAV during this period was 90,000 acres, seen in 2002. However, by 2003, SAV acreage had dropped 30 percent. Even at its maximum extent, SAV coverage in the Bay represents less than half its historic coverage.

The significant changes in SAV distribution in 2003 appear to be the result of substantial reductions in widgeongrass populations in the lower and mid-bay regions. In addition to the large declines in widgeongrass, major declines in freshwater SAV species occurred in the upper portion the Potomac River and Susquehanna region. While populations of SAV appeared to be present in these segments very early in the growing season, the persistent turbidity resulting from rain occurring throughout the spring and summer may have contributed to a very early decline, well before Hurricane Isabel affected Chesapeake Bay (Orth et. al., 2004).

Indicator Limitations

- There were no surveys in the years 1979 through 1983 and 1988.

- The indicator includes partial estimated data for years with incomplete photographic documentation of the survey area. Spatial gaps in 1999 occurred due to hurricane disturbance and subsequent inability to reliably photograph SAV. Spatial gaps in 2001 occurred due to flight restrictions near Washington D.C. after the September 11th terrorist attacks. Other gaps occurred in 2003 due to adverse weather in the spring, summer, and fall (Hurricane Isabel). Estimates of acreage in the non-surveyed areas, based on prior years' surveys, were developed for 1999, 2001, and 2003.

Data Sources

Virginia Institute of Marine Science. The SAV distribution data files are located at http://www.vims.edu/bio/sav/savdata.html. The data used to construct the chart are located at http://www.chesapeakebay.net/pubs/statustrends/88-data-2002.xls. The SAV indicator is published at http://www.chesapeakebay.net/status.cfm?sid=88.

References

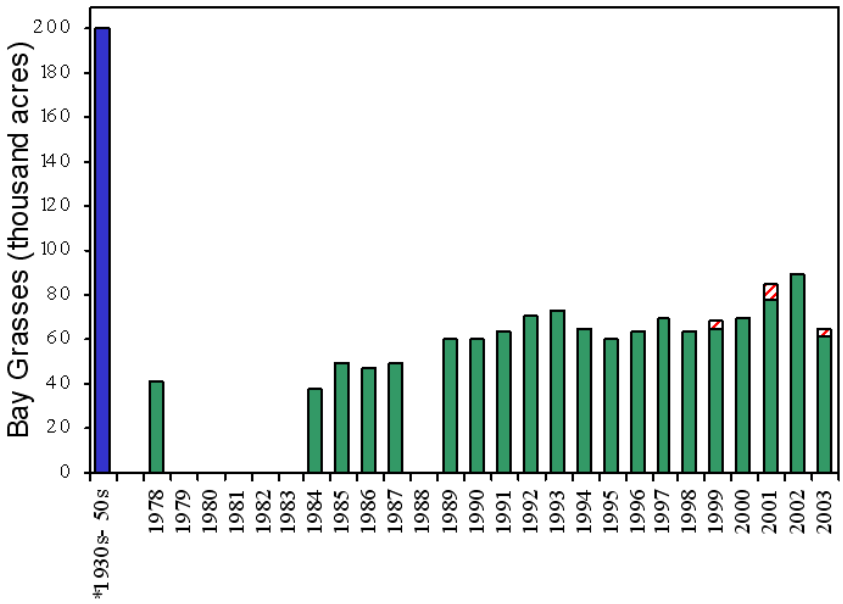
Batiuk, R., P. Bergstrom, M. Kemp, E. Koch, L. Murray, C. Stevenson, R. Bartleson, V. Carter, N. Rybicki, J. Landwehr, C. Gallegos, L. Karrh, M. Naylor, D. Wilcox, K. Moore, S. Ailstock, and M. Teichberg. 2000. Chesapeake Bay submerged aquatic vegetation water quality and habitat-based requirements and restoration targets: A second technical synthesis. CBP/TRS 245/00. EPA 903-R-00-014, U.S. EPA, Chesapeake Bay Program, Annapolis, MD. (http://www.chesapeakebay.net/pubs/sav/savreport.pdf)

Historical analysis of SAV in the Potomac River and Analysis of Bay-wide Historic SAV to establish a New Acreage Goal. K. A. Moore, D. J. Wilcox, B. Anderson, T. A. Parham, and M. D. Naylor. Report to EPA Chesapeake Bay Program. April 2004. (http://www.vims.edu/bio/sav/Final_SAV_Historical_Report_2004.pdf)

2003 Distribution of Submerged Aquatic Vegetation in Chesapeake Bay and Coastal Bays. R. J. Orth, D. J. Wilcox, L. S. Nagey, A. L. Owens, J. R. Whiting, A. Serio. Report to EPA Chesapeake Bay Program. December 2004. (http://www.vims.edu/bio/sav/sav03/index.html)

Graphics

Figure 317R-1: Extent of SAV in Chesapeake Bay (acres), 1978-2003 compared to historic extent



R.O.E. Indicator QA/QC

Data Set Name: SUBMERGED AQUATIC VEGETATION IN CHESAPEAKE BAY
Indicator Number: 317R (89155)
Data Set Source: Virginia Institute of Marine Science via EPA grant
Data Collection Date: 1978-2003, excluding 1979-1983 and 1988
Data Collection Frequency: 1 yr
Data Set Description: Acres of Submerged Aquatic Vegetation in Chesapeake Bay
Primary ROE Question: What are the trends in extent and condition of coastal waters

Question/Response

T1Q1 Are the physical, chemical, or biological measurements upon which this indicator is based widely accepted as scientifically and technically valid?

Yes. Methods developed for this survey are described in "2002 Distribution of submerged aquatic vegetation in the Chesapeake Bay and coastal bays. R. J. Orth, D. J. Wilcox, L. S. Nagey, A. L. Owens, J. R. Whiting, and A. Serio. VIMS Special Scientific Report Number 139. Final report to U.S. EPA, Chesapeake Bay Program, Annapolis, MD. Grant No.CB983649-01-0, 2003." available at http://www.vims.edu/bio/sav/sav02/ This indicator has undergone extensive technical and peer review by state, Federal and non-government organization partner members of the SAV workgroup and the Living Resources subcommittee. Data collection, data analysis and QA/QC is conducted by the principal investigators/scientists. The data are peer reviewed by scientists on the workgroup. Data selection and interpretation, the presentation of the indicator, along with all supporting information and conclusions, are arrived at via consensus by the scientists in collaboration with the resource manager members of the workgroup. The workgroup presents the indicator to the subcommittee where extensive peer review by Bay Program managers occurs. See Chesapeake Bay SAV special reports at http://www.vims.edu/bio/sav/savreports.html and bibliography at http://www.vims.edu/bio/sav/savchespub.html. The SAV distribution data files are located at http://www.vims.edu/bio/sav/savdata.html and also at http://www.chesapeakebay.net/pubs/statustrends/88-data-2002.xls. The SAV indicator is published at http://www.chesapeakebay.net/status.cfm?sid=88.

T1Q2 Is the sampling design and/or monitoring plan used to collect the data over time and space based on sound scientific principles?

Yes. The SAV survey is a general monitoring program, conducted to optimize precision and accuracy in characterizing annually the status and trends of SAV in tidal portions of the Chesapeake Bay. The general plan is to follow fixed flight routes over shallow water areas of the Bay to comprehensively survey all tidal shallow water areas of the Bay and its tidal tributaries. Non-tidal areas are omitted from the survey. SAV beds less than 1 square meter are not included due to the limits of the photography and interpretation. Annual monitoring began in 1978 and is ongoing. Methods are described in the Quality Assurance Project Plan (QAPP) on file for the EPA grant (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov) and at the VIMS web site (http://www.vims.edu/bio/sav/). See Chesapeake Bay SAV special reports at http://www.vims.edu/bio/sav/savreports.html and bibliography at http://www.vims.edu/bio/sav/savchespub.html.

T1Q3 Is the conceptual model used to transform these measurements into an indicator widely accepted as a scientifically sound representation of the phenomenon it indicates?

Yes. This indicator has undergone extensive technical and peer review by state, Federal and non-government organization partner members of the SAV workgroup and the Living Resources subcommittee. Data collection, data analysis and QA/QC is conducted by the principal investigators/scientists. The data are peer reviewed by scientists on the workgroup. Data selection and interpretation, the presentation of the indicator, along with all supporting information and conclusions, are arrived at via consensus by the scientists in collaboration with the resource manager members of the workgroup. The workgroup presents the indicator to the subcommittee where extensive peer review by Bay Program managers occurs. See Chesapeake Bay SAV special reports at http://www.vims.edu/bio/sav/savreports.html and bibliography at http://www.vims.edu/bio/sav/savchespub.html. The SAV distribution data files are located at http://www.vims.edu/bio/sav/savdata.html and also at http://www.chesapeakebay.net/pubs/statustrends/88-data-2002.xls. The SAV indicator is published at http://www.chesapeakebay.net/status.cfm?sid=88.

T2Q1 To what extent is the indicator sampling design and monitoring plan appropriate for answering the relevant question in the ROE?

The SAV survey is a general monitoring program, conducted to optimize precision and accuracy in characterizing annually the status and trends of SAV in tidal portions of the Chesapeake Bay. Methods developed for this survey are described in "2002 Distribution of submerged aquatic vegetation in the Chesapeake Bay and coastal bays. R. J. Orth, D. J. Wilcox, L. S. Nagey, A. L. Owens, J. R. Whiting, and A. Serio. VIMS Special Scientific Report Number 139. Final report to U.S. EPA, Chesapeake Bay Program, Annapolis, MD. Grant No.CB983649-01-0, 2003." available at http://www.vims.edu/bio/sav/sav02/

T2Q2 To what extent does the sampling design represent sensitive populations or ecosystems?

The SAV measure is an indicator of Chesapeake Bay ecosystem health. Trends in the distribution and abundance of SAV over time are useful in understanding trends in water quality.

T2Q3 Are there established reference points, thresholds or ranges of values for this indicator that unambiguously reflect the state of the environment?

Yes. Please refer to Historical analysis of SAV in the Potomac River and Analysis of Bay-wide Historic SAV to establish a New Acreage Goal. K. A. Moore, D. J. Wilcox, B. Anderson, T. A. Parham, and M. D. Naylor. Report to EPA Chesapeake Bay Program. April 2004 at http://www.vims.edu/bio/sav/Final_SAV_Historical_Report_2004.pdf refer to page 12.

T3Q1 What documentation clearly and completely describes the underlying sampling and analytical procedures used?

Please refer to http://www.vims.edu/bio/sav/sav02/report/reportindex_page.html Methods are also described in the Quality Assurance Project Plan (QAPP) on file for the EPA grant (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov) and at the VIMS web site (http://www.vims.edu/bio/sav/). See Chesapeake Bay SAV special reports at http://www.vims.edu/bio/sav/savreports.html and bibliography at http://www.vims.edu/bio/sav/savchespub.html.

T3Q2 Is the complete data set accessible, including metadata, data-dictionaries and embedded definitions or are there confidentiality issues that may limit accessibility to the complete data set?

Yes. Please refer to http://www.vims.edu/bio/sav/sav02/report/reportindex_page.html Methods are also described in the Quality Assurance Project Plan (QAPP) on file for the EPA grant (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov) and at the VIMS web site(http://www.vims.edu/bio/sav/). See Chesapeake Bay SAV special reports at http://www.vims.edu/bio/sav/savreports.html and bibliography at http://www.vims.edu/bio/sav/savchespub.html. Metadata are included with the data set posted at the VIMS web site (http://www.vims.edu/bio/sav/metadata/recent.html)

T3Q3 Are the descriptions of the study or survey design clear, complete and sufficient to enable the study or survey to be reproduced?

Yes. Please refer to http://www.vims.edu/bio/sav/sav02/report/reportindex_page.html Methods are also described in the Quality Assurance Project Plan (QAPP) on file for the EPA grant (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov) and at the VIMS web site (http://www.vims.edu/bio/sav/). See Chesapeake Bay SAV special reports at http://www.vims.edu/bio/sav/savreports.html and bibliography at http://www.vims.edu/bio/sav/savchespub.html.

T3Q4 To what extent are the procedures for quality assurance and quality control of the data documented and accessible?

Quality assurance project plan for the EPA grant to the Virginia Institute of Marine Sciences describes data collection, analysis, and management methods. This is on file at the EPA Chesapeake Bay Program Office (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov). The VIMS web site at http://www.vims.edu/bio/sav/ provides this information as well. Metadata are included with the data set posted at the VIMS web site (http://www.vims.edu/bio/sav/metadata/recent.html)

T4Q1 Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)?

Yes. Values used in the analysis are aggregated data, aggregated by Chesapeake Bay segment. Quality assurance project plan for the EPA grant to the Virginia Institute of Marine Sciences describes data collection, analysis, and management methods. This is on file at the EPA Chesapeake Bay Program Office (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov). The VIMS web site at http://www.vims.edu/bio/sav/ provides this information as well. Metadata are included with the data set posted at the VIMS web site (http://www.vims.edu/bio/sav/metadata/recent.html)

T4Q2 Are uncertainty measurements or estimates available for the indicator and/or the underlying data set?

Yes. Quality assurance project plan for the EPA grant to the Virginia Institute of Marine Sciences describes data collection, analysis, and management methods. This is on file at the EPA Chesapeake Bay Program Office (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov). The VIMS web site at http://www.vims.edu/bio/sav/ provides this information as well. Metadata are included with the data set posted at the VIMS web site (http://www.vims.edu/bio/sav/metadata/recent.html)

T4Q3 Do the uncertainty and variability impact the conclusions that can be inferred from the data and the utility of the indicator?

No. Some technical improvements (e.g., photointerpretation tools) were made over the 16 years of the annual SAV survey in Chesapeake Bay. Surveyors and analysts have carefullly evaluated the effect of methodological changes along the way and made corrections to adjust for any known effects. Quality assurance project plan for the EPA grant to the Virginia Institute of Marine Sciences describes data collection, analysis, and management methods. This is on file at the EPA Chesapeake Bay Program Office (contact: EPA grant project officer, Mike Fritz (fritz.mike@epa.gov). The VIMS web site at http://www.vims.edu/bio/sav/ provides this information as well. Metadata are included with the data set posted at the VIMS web site (http://www.vims.edu/bio/sav/metadata/recent.html)

T4Q4 Are there limitations, or gaps in the data that may mislead a user about fundamental trends in the indicator over space or time period for which data are available?

Due to funding constraints, there were no surveys in the years 1979-1983 and 1988. Spatial gaps in 1999 occurred due to hurricane disturbance and subsequent inability to reliably photograph SAV. Spatial gaps in 2001 occurred due to post-nine-eleven flight restrictions near Washington D.C. Spatial gaps in 2003 occurred due to adverse weather in the spring and summer and Hurricane Isabel in the fall. Estimates of acreage in the non-surveyed areas, based on prior year surveys, were developed for those years (1999, 2001, 2003).